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Craig Hansen

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EXAMINER

MOLL, JESSE R

ART UNIT

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2181

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/757,939	Applicant(s) HANSEN ET AL.	
	Examiner JESSE R. MOLL	Art Unit 2181	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 February 2009.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-28 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-28 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>7/31/2008 8/6/2008</u> | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. Claims 1-28 have been examined.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1, 6-8, 12, 13, 18-20 and 24-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cray, Jr. (U.S. Patent No. 4,128,880) herein referred to as Cray in view of Chen et al. (U.S. Patent No. 4,661,900) herein referred to as Chen.
4. Referring to claim 1, Cray discloses, as claimed, a programmable processor (as shown in figure 2) comprising: a data path (Such as lines carrying V_i , V_k and V_l and data path 21; see fig. 2), lines capable of transmitting data (inherently, by definition, a data path is capable of transmitting data); an external interface operable to receive data from an external source (Memory 12) and communicate the received data over the data path (see col. 4; lines 3-8); a register file containing a plurality of registers (Vector Registers 20; see fig. 2) each having a register width (64 elements wide; see col. 3, lines 50-62),

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the register file coupled to the data path and configured to support processing of a plurality of threads (programs; see Col. 9, lines 38-43) and to store a plurality of multiple-bit data elements in partitioned fields (see col. 3, lines 50-62), each of the multiple-bit data elements having an elemental width (64 bit) smaller than the register width (4096 bit); an execution unit (Including Vector Functional Units; see fig. 2) coupled to the data path (see fig. 2), the execution unit configured to execute a plurality of instruction streams from the plurality of threads (see Col. 9, lines 38-43), each instruction stream including a single instruction (such as the instruction shown in Fig. 3A; col. 9, lines 44-50; any instruction stream will inherently include at least 1 instruction) that specifies an arithmetic operation (addition; see col. 8, lines 28-35) to cause multiple instances of the operation to be performed, each instance of the arithmetic operation to be performed using a different one of the plurality of multiple-bit data elements (see col. 10, lines 19-50) in partitioned fields of at least one of the registers to produce a catenated result (result register; see col. 5, 60-65) and execute multiple instances of the arithmetic instruction to produce the catenated result (The results must be catenated into the destination register V_I).

Note claims 8, 13, and 20 recite the corresponding limitations as set forth above in claim 1. Peleg also discloses as to Claims 8 and 20 first and second registers (such as registers V0-V3 and V4-V7).

Cray does not expressly disclose wherein each of the multiple-bit data elements has an elemental width, and the data path has a data path width multiple times greater than the elemental width, to allow multiple-bit data elements used for the multiple

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instances of the arithmetic operation to be transmitted in parallel from the register file to the execution unit, and wherein the execution unit is operable to receive, in parallel, multiple-bit data elements for the multiple instances of the arithmetic operation.

Chen teaches each of the multiple-bit data elements has an elemental width, and the data path has a data path width multiple times greater than the elemental width (Double; see col. 18, lines 38-45), to allow multiple-bit data elements used for the multiple instances of the arithmetic operation to be transmitted in parallel from the register file to the execution unit (See col. 19, lines 49-51), and wherein the execution unit is operable to receive, in parallel, multiple-bit data elements for the multiple instances of the arithmetic operation (See col. 19, lines 49-51).

At the time of the invention, it would have been obvious for one of ordinary skill in the art to have modified the invention of Cray by using two banks of vector registers and using two vector functional units, as taught by Chen, in order to increase data throughput.

5. As to claim 6, Cray also discloses: the processor of claim 1 further comprising a virtual memory addressing unit and a cache operable to store data communicated between the external interface (certainly existing in Cray's system for handling input/output operation for peripherals) and the data path. Claim 18 recites the corresponding limitations as set forth above in claim 6.

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6. As to claim 7, Cray also discloses: the processor of claim 1 wherein the execution unit is further operable to, in response to decoding a second single instruction specifying a first and a second register (V_j , and V_k ; see fig. 2; col. 9, lines 44-58) each containing a plurality of operands (Vector register elements; see col. 5, lines 45-60), multiply the plurality of floating point operands (see col. 8, lines 49-53) in the first register (V_j) by the plurality of in the second register (V_k) to produce a plurality of products and provide the plurality of products to partitioned fields of a result register (V_i ; see col. 5, lines 45-65) as a second catenated result. Note Claims 12, 19, and 24 recite the corresponding limitations as set forth above in claim 7.

7. As to claim 25, Cray also discloses the arithmetic operation comprises an integer operation (see col. 11, lines 13-24). Note Claims 27 recites the corresponding limitations as set forth above in claim 26.

8. As to claim 26, Cray also discloses the arithmetic operation comprises a floating-point operation (see col. 17, lines 13-26). Note Claims 27 recites the corresponding limitations as set forth above in claim 26 and claim 28 recites equivalent limitations as 13 and 26 discussed above.

9. Claims 2-5, 9-11, 14-17 and 21-23 rejected under 35 U.S.C. 103(a) as being unpatentable over Cray in view of Chen and in further view of Laudon et al.

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(Interleaving: a Multithreading Technique Targeting Multiprocessor and Workstations)
herein referred to as Laudon.

10. As to claims 2, 9, 14 and 21, Cray/Chen does not expressly disclose the execution unit comprises a pipeline having a plurality of stages and wherein the pipeline interleaves execution of instructions from the plurality of instruction streams.

11. As to claims 3, 10, 15 and 22, Cray/Chen does not expressly disclose the pipeline is operable to simultaneously contain states of execution of at least two instructions from different instruction streams.

12. As to claims 4, 11, 16 and 23, Cray/Chen does not expressly disclose execution of the instructions is interleaved in a round-robin manner.

13. As to claims 5 and 17, Cray/Chen does not expressly disclose the processor ensures only one thread from the plurality of threads can handle an exception at any given time

14. Laudon teaches the execution unit comprises a pipeline having a plurality of stages (see page 311, Figure 5) and wherein the pipeline interleaves execution of

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instructions from the plurality of instruction streams (see page 310, Figure 3, Interleaved Scheme).

15. Laudon teaches the pipeline is operable to simultaneously contain states of execution of at least two instructions from different instruction streams (see page 310, Figure 3, Interleaved Scheme).

16. Laudon teaches execution of the instructions is interleaved in a round-robin manner (see page 310, Figure 3, Interleaved Scheme).

17. Laudon teaches the processor ensures only one thread from the plurality of threads can handle an exception at any given time (see page 315, right column).

18. It would have been obvious for one of ordinary skill in the art at the time of the invention to have modified the combination of Cray and Chen (as shown above) by modifying the execution unit to comprise a pipeline having a plurality of stages and wherein the pipeline interleaves execution of instructions from the plurality of instruction streams wherein the pipeline is operable to simultaneously contain states of execution of at least two instructions from different instruction streams interleaved in a round-robin manner ensuring only one thread from the plurality of threads can handle an exception at any given time, as taught by Laudon, in order to increase performance (see Laudon, page 313, Table 7).

Response to Arguments

Applicant's arguments with respect to claims 1-28 have been considered but are not persuasive.

The arguments directed to transmission multiple instances of an arithmetic operation are moot in view of the new grounds of rejection presented above.

The arguments directed to receiving multiple instances of an arithmetic operation are moot in view of the new grounds of rejection presented above. Additionally, even if the elements are calculated 1 at a time, the results are eventually catenated and stored in the register file.

Regarding the arguments directed to executing a plurality of instruction streams from a plurality of threads, Examiner respectfully disagrees. As shown above in the rejection under 35 USC 103, Cray teaches the use of context switching to switch instruction streams from multiple threads (programs; see Col. 9, lines 38-43). Additionally, it is extremely commonly known in the art that processors can run multiple threads. Almost no processors actually run a single program.

Conclusion

19. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jesse R. Moll whose telephone number is (571)272-2703. The examiner can normally be reached on M-F 10:00 am - 6:30 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alford Kindred can be reached on (571)272-4037. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

20. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Alford W. Kindred/
Supervisory Patent Examiner, Art
Unit 2181

/J. R. M./

Examiner, Art Unit 2181